

Answers to Questions

1. Explain what is happening during each of the following regions of the graph of Figure 2—region A to B, region B to C, and region C to D.
 - a. Region A to B *[The reel is accelerating down the ramp on its axle.]*
 - b. Region B to C *[The reel outer rims are touching the floor.]*
 - c. Region C to D *[The reel is rolling along the floor on its outer rims.]*
2. What is the angular velocity in rad/s of the reel just before making contact with the floor?
[Based upon the provided Excel graph of Figure 2, it appears to be about 1412 °/s, or $1412/360 \times 2\pi = 24.6$ rad/s.]
3. What is the translational speed of the reel just **before** making contact with the floor? *[Since $v = \omega r$ and we know ω from the answer to question 2, we need the radius of the axle, which is the current moment arm of the reel. It is 5.08 cm = 0.0508 m. Therefore, the translational speed just before making contact with the table top is $24.6/s \times 0.0508 \text{ m} = 1.25 \text{ m/s}$.]*
4. What is the angular velocity in rad/s of the reel just **after** making contact with the floor? *[Based upon the provided Excel graph of Figure 2, it appears to be about 880 °/s, or $880/360 \times 2\pi = 15.4$ rad/s.]*
5. What is the translational speed of the reel just after making contact with the floor? *[Again, since $v = \omega r$ and we know ω from the answer to question 4, we need the radius of the outer rim, which is the current moment arm of the reel. It is 0.102 m. Therefore, the translational speed just after making contact with the table top is $15.4/s \times 0.102 \text{ m} = 1.57 \text{ m/s}$. We note that the translational speed has increased by 25.6%! This explains the name “speeder upper”.]*
6. Discuss the physics of why the translational speed increased when the reel contacted the floor.
[While some of the rotational kinetic energy that the reel gained while rolling down the ramp may have been lost due to friction, enough of the rotational kinetic energy has been transferred to translational kinetic energy of the reel to increase the translational speed of the center of mass.]